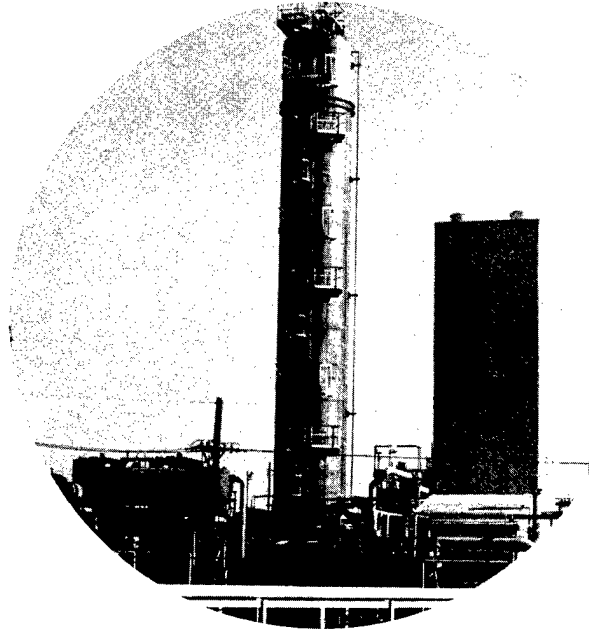


FINAL SUBMISSION
EXECUTIVE SUMMARY



JOLIET
ARMY AMMUNITION PLANT

ENERGY ENGINEERING ANALYSIS



Prepared for



The Department of the Army

Omaha District
Corps of Engineers
Contract No. DACA45-80-C-0090

By



Sanders & Thomas, Inc.

An STV Engineers Professional Firm
Consulting Engineers
Pottstown, Pennsylvania 19464

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May 14, 1982

U.S. Army Corps of Engineers
Omaha District
6014 U.S. Post Office and Court House
Omaha, NE 68102

Attention: MROED-MC

Reference: Energy Engineering Analysis
Joliet Army Ammunition Plant
Joliet, Illinois

Subject: Energy Engineering Analysis - Final Submission

Contract No.: DACA45-80-C-0090

Our Project No.: 05-4660

Gentlemen:

This letter transmits the Final Submission of the Energy Engineering Analysis for the Joliet Army Ammunition Plant, Joliet, Illinois. The Analysis presents energy conservation projects that will enable the plant to meet energy consumption reduction goals, as specified in the Army Facilities Energy Plan.

The Analysis consists of seven components:

- . Executive Summary
- . Technical Report
- . Appendix I: Master Building List
- . Appendix II: Energy Conservation Calculations and Data
- . Appendix III: Energy Conservation Measures Summaries
- . Appendix III: Energy Conservation Measures
- . Project Programming Documents

All comments have been reviewed and incorporated in the report, as appropriate.

This Energy Engineering Analysis is a valuable data base that can be used for the development of additional projects as Army goals are revised and other energy conservation projects become viable.

SANDERS & THOMAS.
AN STV ENGINEERS PROFESSIONAL FIRM

U.S. Army Corps of Engineers
Attention: MROED-MC

May 14, 1982
Page 2

The assistance that was provided by plant and COE personnel proved invaluable in completing this assignment. We appreciate their cooperation and hospitality.

Thank you for this opportunity to be of service.

Very truly yours,

SANDERS & THOMAS, INC.



David M. Jonik, P.E.
Project Manager

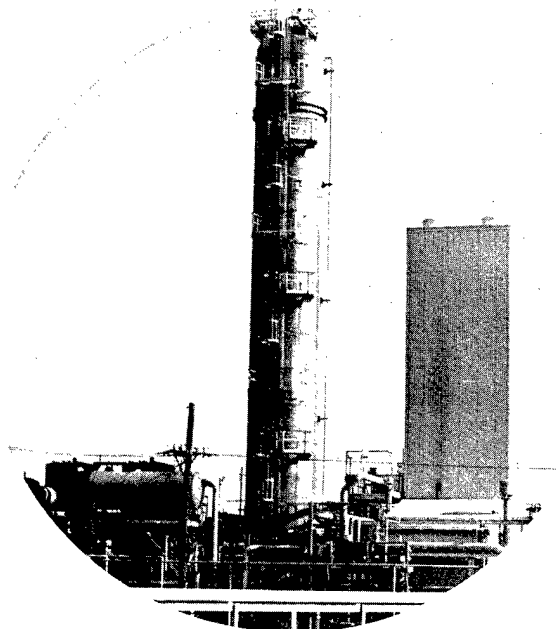
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FINAL SUBMISSION
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MAY 1982

PROJECT ABSTRACT

ENERGY ENGINEERING ANALYSIS
JOLIET ARMY AMMUNITION PLANT

This analysis is undertaken to assist the Joliet Army Ammunition Plant (JAAP) in meeting the goals established in the Army Facilities Energy Plan to reduce energy consumption by 25 percent by 1985.

Projects selected for implementation as a result of this analysis will enable JAAP to achieve the 1985 goal. These projects have been divided into standby status and mobilization status. Total annual energy savings for standby status from project implementation will be approximately 290,000 MBTU's. The total cost of project implementation is estimated at \$2.6 million. If mobilization status projects are implemented annual energy savings will be approximately 600,000 MBTU's during periods of full mobilization. The cost of implementing mobilization status projects is estimated at \$5.9 million.

USE OF THE REPORT

This Energy Engineering Analysis consists of the main report, three appendices, and a summary of annual energy consumption on a "per-building" basis. The main report identifies the purpose of the study, describes the existing and anticipated energy use trends, and defines and summarizes specific energy conservation projects recommended to achieve the goals stated in the Army Facilities Energy Plan. Appendices I, II and III, and the Annual Energy Consumption Summary include building information, weather data, cost data, and detailed computer-generated and manual calculations for each individual project.

The analysis will enable ammunition plant personnel to identify energy conservation measures and meet Army energy reduction goals.

The report includes:

- . Energy consumption by fuel type
- . Energy consumption trends
- . ECAM projects
- . Other potential projects
- . Quick-fix management form
- . Description of analyzed buildings

In addition, the Analysis is a detailed data base consisting of:

- . An analysis of building energy use
- . Energy Conservation Measures applied to each analyzed building to be improved
- . A set of marked-up prints from the survey indicating the conditions when surveyed.

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EXECUTIVE SUMMARY

1.1 PROJECT REQUIREMENT

This engineering analysis is undertaken in order to develop a systematic program of projects that will lead to energy consumption reductions at the Joliet Army Ammunition Plant (JAAP) without compromising the mission of the plant, and in compliance with all applicable environmental and Occupational Safety and Health Administration regulations. Reduced energy consumption is a stated goal of the Army Facilities Energy Plan.

The projects included in this analysis are grouped into four increments: A - Energy Conservation and Management Program (ECAM) projects for buildings and processes, B - ECAM projects for utilities and energy distribution systems, E - Feasibility of central boiler plants, and G - Maintenance, repair, and minor construction projects.

2.1 PLANT DESCRIPTION

JAAP is the Army's largest ammunition plant with over 1,500 buildings on a 22,500 acre site 11 miles south of Joliet, Illinois. The location of the plant is shown on Figure 1: Joliet Army Ammunition Plant Location Map.

The plant is divided into two main functional areas: The Load, Assemble, and Pack (LAP) Area and the Manufacturing Area. Figure 2: Joliet Army Ammunition Plant General Site Map, shows the key features of the plant.

3.1 ARMY FACILITIES ENERGY PLAN

The Army Facilities Energy Plan sets short and long range energy goals for the Army and provide policy and planning guidance for the development of detailed facility energy plans. The Army's energy goals are to:

- Reduce total facility energy consumption by at least 25 percent by FY 1985 and by 50 percent by FY 2000, using FY 1975 as the base year.
- Reduce FY 85 average annual energy consumption per gross square foot of floor area by 45 percent in new buildings compared to FY 1975.
- Derive ten percent of Army facility energy from coal and alternate fuels by FY 1985.
- Derive one percent of Army facility energy from solar energy by FY 1985.
- Eliminate use of natural gas by FY 2000.
- Reduce facility use of petroleum fuels by 75 percent by FY 2000.

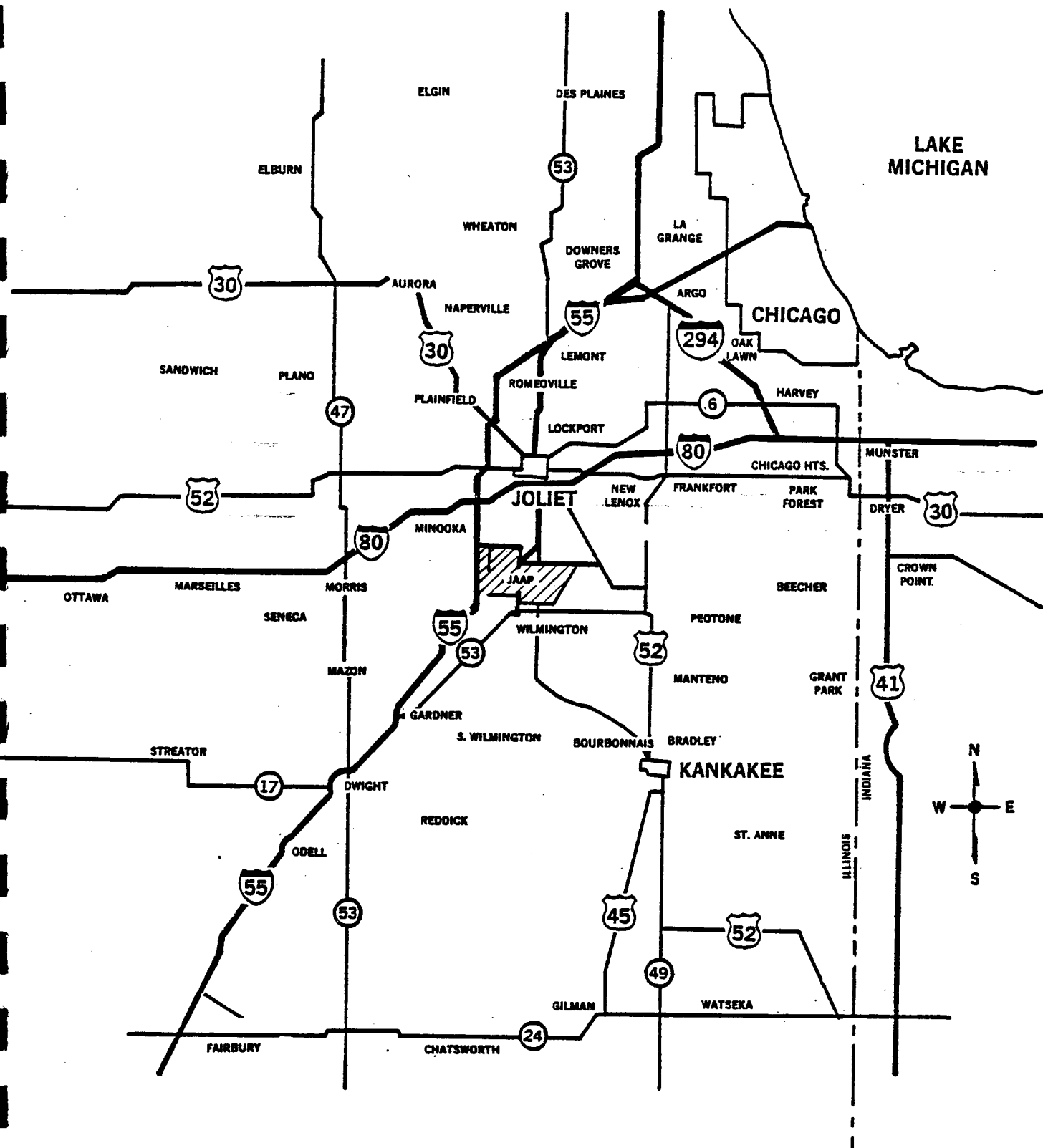


FIGURE 1
JOLIET ARMY AMMUNITION PLANT
LOCATION MAP

0 25
MILES
SCALE

4.1 SOURCE ENERGY CONSUMPTION

Table 1: Source Energy Consumption, compares consumption from FY 1975, the base year for the study, with consumption during FY 1979. Fuel consumption over the period dropped considerably as a result of the shutdown of the plant's process facilities.

TABLE 1

SOURCE ENERGY CONSUMPTION
FY 1975 AND 1979

<u>Source</u>	<u>FY 1975</u>		<u>FY 1979</u>	
	<u>Cost</u> <u>(\$000)</u>	<u>MBTU's</u> <u>Consumed</u> <u>(000)</u>	<u>Cost</u> <u>(\$000)</u>	<u>MBTU's</u> <u>Consumed</u> <u>(000)</u>
Electricity	\$1,093	746	\$ 344	135
Fuel Oil No. 2	48	24	17	5
Natural Gas	1,081	1,259	808	353
Propane Gas	<u>285</u>	<u>79</u>	<u>-0-</u>	<u>-0-</u>
Totals	\$2,507	2,108	\$1,169	493

Current fuel consumption is primarily attributed to building as opposed to process requirements. Consumption varies depending upon the number of degree days experienced. Electrical consumption is relatively constant throughout the year.

JAAP is currently 98 percent on standby status and its energy usage is limited to building heating, cooling and lighting and utility systems. During active periods, the plant's energy consumption increases due to process requirements. "Energy Consumption: Mobilization Versus Standby Status" shown in Figure 3 depicts the various quantities of energy the base will consume during inactivity, partial mobilization (six continuous TNT lines), and full mobilization (six continuous, ten batch TNT lines and tetryl).

5.1 PROJECT EXECUTION

This energy engineering analysis was conducted in the following phases:

- . Field surveys and data gathering
- . Analysis of projects
- . Review and verification
- . Preparation of Project Programming Documents

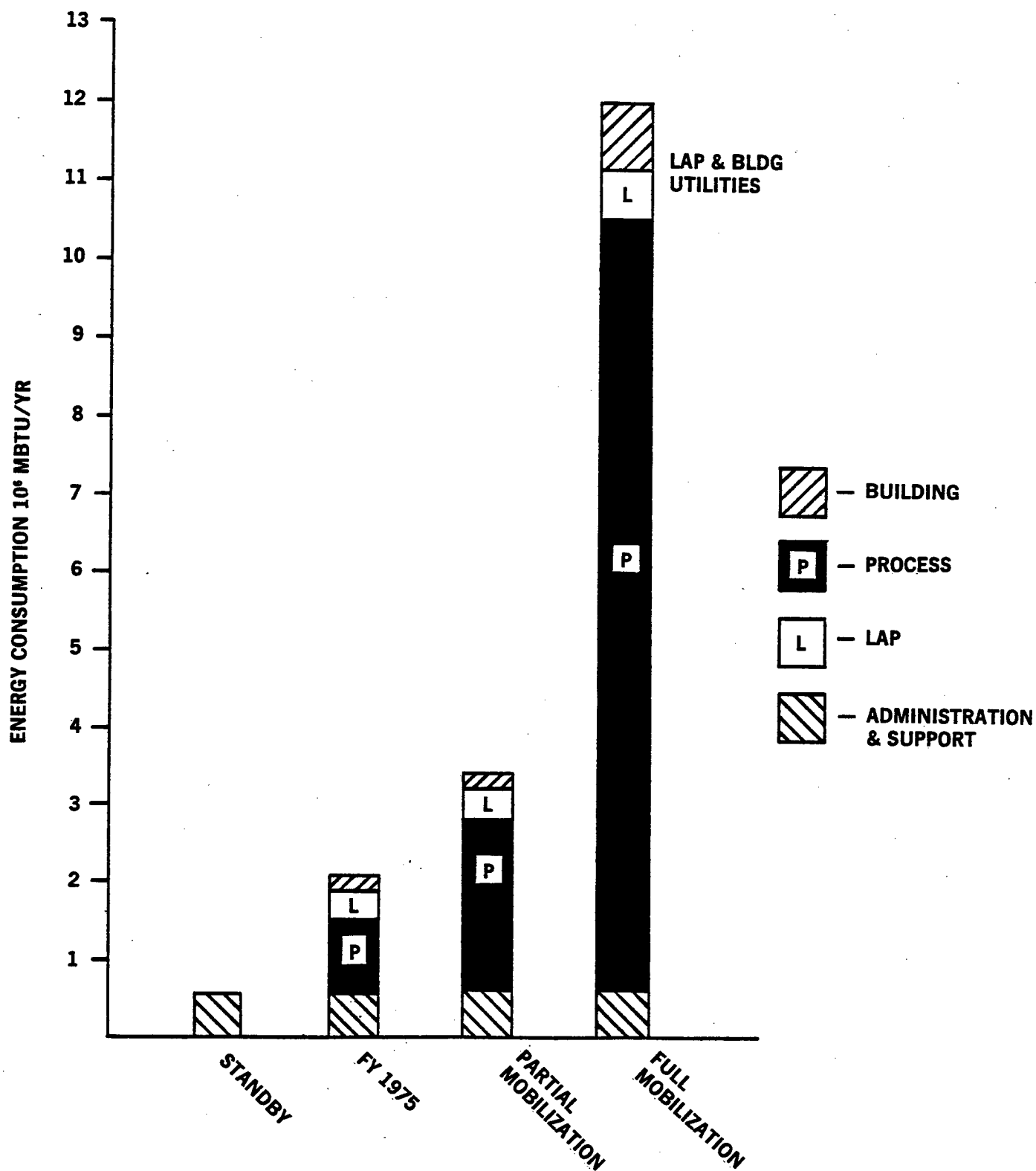


FIGURE 3
ENERGY CONSUMPTION: MOBILIZATION VERSUS STANDBY STATUS

5.1.1 Field Surveys and Data Gathering

The field surveys included buildings and process surveys. The building surveys were conducted in four areas:

- . Architectural - to evaluate such items as wall and roof types, and levels of insulation.
- . Mechanical - to evaluate heating, ventilating, and air conditioning systems
- . Electrical - to evaluate lighting and building electrical systems
- . Distribution - to evaluate plant utility systems

The process surveys addressed the processes conducted at the plant including nitrating acid, TNT, tetryl, and the various recovery systems in operation.

The distribution surveys covered all plant utility systems including electrical, steam, natural gas, water, sewage, and compressed air.

The survey phase provided a basis for the identification of energy conservation opportunities and the applicability of energy conservation measures to JAAP.

A study was also conducted to determine the feasibility of utilizing central heating plants in the LAP and Manufacturing Areas.

5.1.2 Analysis of Projects

After the data gathering phase it was possible to identify potential projects for analysis. These projects were analyzed for applicability to JAAP and their potential to save energy in relation to their implementation cost.

5.1.3 Review and Verification

JAAP personnel assisted in the selection of those projects which should be implemented and developed project priorities. All projects were reviewed and verified at the plant in consultation with JAAP personnel.

6.1 ENERGY CONSERVATION OPPORTUNITIES

The following energy conservation opportunities were investigated and found to be viable:

Insulation
Storm Windows
Caulking
Weatherstripping

Modify Hot Water Heater Controls
Install Shower Flow Restrictors
Reduce Ventilation Requirements
Heat Destratification

Load Dock Seals
Reduce Glass Area
Reduce Lighting Levels
Replace Incandescent Fixtures
Install Fluorescent Fixtures
Install High-Efficiency
Fixtures
Oxygen Control for Boilers

Blowdown Heat Recovery
Boiler Modulating Controls
Install Economizers
Install New Burners
Reduce Street Lighting
Insulate Steam Lines
Return Condensate

The following conservation opportunities were studied but found not viable because of low ECR or lack of conservation opportunity at the plant:

- . Improve power factor
- . High-efficiency motor replacement
- . FM radio controls
- . Decentralize domestic hot water heaters
- . Reclaim heat from hot refrigerant gas
- . Install chiller controls
- . Replace chillers

7.1 PROJECTS SUMMARY

7.1.1 Introduction

A complete listing of all ECAM, Increment "G" and other projects is provided in project number order. This is followed by specific categories of projects arranged in priority order according to descending ECR. A summary of project categories completes this section in Table 7: Summary of Projects.

7.1.2 Selected ECAM Projects

ECAM Projects selected by JAAP personnel at the Review and Verification Meeting are presented in Table 2: Selected ECAM Projects. Projects are separated by standby or mobilization status and listed in order of descending ECR.

7.1.3 Viable Projects Not Selected For Implementation By JAAP

Table 3: Viable Projects Not Selected for Implementation by JAAP, includes those projects not selected for implementation by JAAP personnel. These projects were not selected because anticipated procedural changes at the plant would make these projects unnecessary and other projects have accomplished the same purpose. Projects are separated by standby and mobilization status and listed in order of descending ECR.

7.1.4 Energy Conservation Measures Not Meeting ECAM Criteria

Those portions of ECM Nos. 2 through 8 not included in selected ECAM projects or Increment "G" projects are summarized in Table 4: Energy Conservation Measures Not Meeting ECAM Criteria. Annual MBTU savings, CWE, TIC, and ECR data are included for the unselected portion of

each ECM. A complete itemization of individual building projects from which future implementation selection could be made appears in Appendix III.

7.1.5 Increment "G" - Minor Construction, Maintenance and Repair Projects

Table 5: Increment "G" - Minor Construction, Maintenance and Repair Projects, lists qualifying projects by descending ECR.

7.1.6 Non-Viable or Out-of-Scope Projects

Table 6: Non-Viable or Out-of-Scope Projects lists those energy conservation projects not in accordance with ECAM guidance or not included within the scope of work.

7.1.7 Increment "E" - Central Boiler Plant Projects

Central boiler plant projects were developed for the LAP and Manufacturing Areas. Recommended projects are as follows:

- LAP Area: Coal Fired, High Temperature Water System - Project Cost = \$35,240,000;
- Manufacturing Area: Upgrade South Boiler Plant to burn coal; utilize existing steam distribution system - Project Cost = \$29,000,000.

7.1.8 Installation of Independent Heating Systems (Package Boilers)

JAAP personnel have developed a project to install package boilers when power house operations are discontinued. This is a viable project and the energy savings are included in the total energy savings figure for FY 1981 to FY 1985 energy projects.

7.1.8.1 Project Calculation Summary

- Annual Energy Savings: 271,900 MBTU's
- FY 82 Annual Cost Savings: \$1,322,000
- Benefits: \$32,572,000
- FY 82 CWE: \$1,957,000
- FY 82 TIC: \$1,957,000
- ECR: 138.9
- BCR: 16.6
- SAP: 1.4 years

7.1.9 Projected Energy Trends

Figure 4: Standby Status-Projected Energy Consumption, shows the projected trend in energy consumption over the period FY 1975 to FY 2000. From FY 1981 to FY 1985, when the energy projects will be implemented, energy use will be reduced by approximately 290,000 MBTU's per year. Building energy use will be reduced from 130 to 30 KBTU's per gross square foot per year over the same period.

TABLE 2

SELECTED ECAM PROJECTS

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings (\$000)	Benefits (\$000)	CWE (\$000)	TIC (\$000)	SAP	BCR	ECR
	<u>FY 84 Standby Status</u>								
6-6	ECAM Project to Repair Damaged Insulation on 150 PSIG Steam System, Manufacturing Area - Standby Status	5,440	42	833	70	74	1.7	11.3	78.0
5-1	ECAM Project to Insulate Roofs for Selected Buildings - Standby Status	7,590	56	1,114	281	295	5.0	3.8	27.0
5-2	ECAM Project to Insulate Walls for Selected Buildings - Standby Status	4,930	37	741	236	249	6.4	3.0	20.8
	SUBTOTAL	17,960	135	2,688	587	618			
	<u>FY 84 Mobilization Status</u>								
10-2	ECAM Project to Preheat Boiler Feedwater with Cooling Tower Return Water - Mobilization Status	179,000	259	9,025	594	625	0.4	43.8	301.3
9-2	ECAM Project to Recover Heat from Redwater Condensate - Mobilization Status	238,400	1,044	20,934	2,135	2,247	2.0	9.3	111.7
7-8	ECAM Project to Improve LAP Boiler Plants - Mobilization Status	27,300	208	4,173	272	286	1.3	14.6	100.3
6-3	ECAM Project to Repair Damaged Insulation on 150 PSIG Steam System, Manufacturing Area - Mobilization Status	19,360	148	2,962	194	204	1.3	14.5	99.6
5-10	ECAM Project to Insulate Roofs on Selected Buildings - Mobilization Status	8,530	62	1,235	112	118	1.8	10.5	76.1

TABLE 2 (Continued)

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings (\$000)	Benefits (\$000)	CWE (\$000)	TIC (\$000)	SAP	BCR	ECR
<u>FY 84 Mobilization Status (Continued)</u>									
5-8	ECAM Project to Insulate Roofs and Walls, Repair Condensate Return System, Group 2 - Mobilization Status	21,190	162	3,241	380	400	2.4	8.1	55.8
5-7	ECAM Project to Insulate Roofs and Walls, Repair Condensate Return System, Group 1 - Mobilization Status	40,160	306	6,144	801	853	2.6	7.2	50.1
5-11	ECAM Project to Insulate Walls on Selected Buildings - Mobilization Status	6,820	48	956	120	127	2.3	8.2	56.7
5-9	ECAM Project to Insulate Roofs and Walls, Repair Condensate Return System, Group 3 - Mobilization Status	35,350	270	5,407	782	823	2.9	6.6	45.2
5-15	ECAM Project to Insulate Roofs and Walls on Selected Buildings - Mobilization Status	7,480	56	1,118	220	231	3.9	4.8	34.0
SUBTOTAL		583,590	2,563	55,195	5,610	5,914			

TABLE 3

VIALE PROJECTS NOT SELECTED FOR IMPLEMENTATION BY JAAP

Project No.	Project Title	Annual MBTU Savings	FY 84 'CWE' (\$000)	FY 84 TIC (\$000)	SAP	BCR	ECR
<u>FY 84 Standby Status</u>							
6-7*	New Insulation of 150 PSIG Steam Distribution System, Manufacturing Area	17,300	877	923	11.6	1.6	19.7
5-16	Family Housing Improvements	1,000	65	72	8.5	1.1	15.4
	SUBTOTAL	1,000	65	72			
<u>FY 84 Mobilization Status</u>							
9-2	Recover Heat from Redwater Condensate	238,400	2,135	2,247	2.0	9.3	111.7
7-9	Replace Combustion Controls in North Plant	89,600	1,061	1,117	2.7	7.0	84.4
10-1	Coordinate Steam Plant Output with Steam Producing Processes	112,000	1,751	1,843	3.6	5.3	63.9
7-1**	Improve LAP Boiler Plants - Group 1	30,300	640	674	2.8	6.9	47.3
7-3**	Improve LAP Boiler Plants - Group 3	28,500	683	719	3.1	6.1	41.8
6-5**	Repair Condensate Return System	52,750	1,300	1,368	3.2	5.9	40.6
6-4**	Replace Existing Insulation on 150 and 300 PSIG Steam Distribution Systems, Manufacturing Area	84,600	2,453	2,582	6.6	2.9	34.5
CL-7**	Improve LAP Boiler Plants - Group 70	8,800	389	410	5.8	3.3	22.6

* Project 6-7 is supplanted by selected ECAM project 6-6 and is not included in the subtotal.

**Portions of projects 6-4, 6-5, 7-1, 7-3 and 7-7 have been allocated to selected ECAM projects. These duplications of energy savings and cost are listed below this table and are deducted to obtain the adjusted subtotal.

TABLE 3 (Continued)

Project No.	Project Title	Annual MBTU Savings	FY 84 CWE (\$000)	FY 84 TIC (\$000)	SAP	BCR	ECR
7-6	Improve LAP Boiler Plants - Group 60	6,900	323	340	6.1	3.1	21.4
7-2	Improve LAP Boiler Plants - Group 2	6,000	321	338	7.0	2.7	18.8
7-4	Improve LAP Boiler Plants - Group 5	4,600	282	297	8.0	2.4	16.4
7-5	Improve LAP Boiler Plants - Group 7	4,600	282	297	8.0	2.4	16.4
6-1	Remove Existing Incandescent and Mercury Vapor Street and Area Lighting Fixtures and Replace with High-Pressure Sodium Fixtures	17,800	1,242	1,307	11.7	1.4	14.4
	SUBTOTAL	684,930	12,901	13,722			
	ADJUSTMENT	-146,510	-3,361	-3,536			
	ADJUSTED SUBTOTAL	538,420	9,540	10,186			

<u>Adjustments</u>		<u>Project Allocated To Project No.</u>		
6-4	Replace Existing Insulation on 150 and 300 PSIG Steam Distribution Systems, Manufac- turing Area	67,100	1,884	1,983
6-5	Repair Condensate Return System	47,060	1,205	1,268
7-1	Improve LAP Boiler Plants - Group 1	20,830	188	197
7-3	Improve LAP Boiler Plants - Group 3	9,010	60	63
7-7	Improve LAP Boiler Plants - Group 70	2,510	24	25
TOTAL ADJUSTMENT		146,510	3,361	3,536

TABLE 4

ENERGY CONSERVATION MEASURES NOT MEETING ECAM CRITERIA*

<u>ECM No.</u>	<u>Annual MBTU Savings</u>	<u>FY 84 CWE (\$000)</u>	<u>FY 84 TIC (\$000)</u>	<u>ECR</u>
2	58,600	1,438	1,613	40.8
3	7,500	212	223	35.4
4	2,590	104	109	24.9
5	8,120	500	526	16.2
6	10,600	1,601	1,685	6.6
7	61,180	7,151	7,527	8.6
8	<u>240</u>	<u>0.6</u>	<u>0.7</u>	398.0
TOTAL	148,830	11,007	11,684	

*Those portions of ECM Nos. 2 through 8, not included in selected ECAM projects or Increment "G" projects, are summarized in this table.

TABLE 5

INCREMENT "G" MINOR CONSTRUCTION, MAINTENANCE AND REPAIR PROJECTS

Project No.	Project Title	Annual MBTU Savings	FY 84 Annual Cost Savings (\$000)	FY 84 TIC (\$000)	ECR	SAP	Manhours
<u>FY 84 Standby Status</u>							
5-6	Reduce the Number of Lamps in Selected Buildings	640	3.3	8.9	75.8	2.6	440
5-3	Insulate Windows or Install Storm Windows on Selected Bldgs. - Standby Status	1,360	10.3	23	62.6	2.1	1,150
5-5	Replace Lighting Fixtures in Selected Bldgs. - Standby Status	620	3.2	29	22.6	8.7	1,450
5-4	Weatherstrip and Caulk Windows and Doors on Selected Bldgs. - Standby Status	340	2.6	19	18.7	7.0	950
5-16	Family Housing Improvements - Standby Status	1,000	7.6	72	15.4	8.5	3,600
12-1	Insulate Steam and Condensate Return Lines - Bldg. 714	150	0.67	1.5	103.7	2.2	30
	Insulate Steam and Condensate Return Lines - Bldg. 61-7	180	1.4	3.0	65.6	2.0	71
12-2	Heat Destratification - Bldg. 716.2	260	1.2	5.4	52.0	4.4	88
	Heat Destratification - Bldg. 717	1,620	7.1	18.2	93.8	2.4	301
	Heat Destratification - Bldg. 718-1	220	0.95	4.3	53.3	4.3	74
	SUBTOTAL	6,400	38	184			
<u>FY 84 Mobilization Status</u>							
5-14	Replace Lighting Fixtures in Selected Bldgs. - Mobilization Status	8,600	44	92	98.8	2.0	4,600
5-12	Insulate Windows and/or Install Storm Windows on Selected Bldgs. - Mobilization Status	2,510	19	30	86.7	1.5	1,500
5-13	Weatherstrip and Caulk Windows and Doors on Selected Bldgs. - Mobilization Status	1,340	10	60	23.5	5.6	3,000
	SUBTOTAL	12,450	73	182			

TABLE 6

NON-VIABLE OR OUT-OF-SCOPE PROJECTS

I NON-VIABLE PROJECTS

<u>Project</u>	<u>Annual MBTU Savings</u>	<u>FY 84 TIC (\$000)</u>	<u>ECR</u>
EMCS Projects (includes ECM No's. 9 and 10)	3,500	616	6.0

II OUT-OF-SCOPE PROJECTS

Install Low Capacity Burner on One
Boiler, North Power Plant

Preheat Spent Acid from TNT Lines

(AFR) Replace John Zinc Unit with
Scrubber

(AOP) Preheat Tail Gases with
Process Gas

(AOP) Adjust Loading on Compressor
and Hot Gas Expander

(AOP) Use Molecular Sieve Instead
of Tail Gas Incinerator

(DSN) Use Steam Absorption Chiller
Instead of Electric-Driven

(NAC) Use Thermo Plastic Lined
Transfer Piping to Acid Recovery
Buildings Eliminate Cooling
Requirement

Preheat Feed to Concentrator Tower
on Acid Recovery Building

TABLE 7

SUMMARY OF PROJECTS

	<u>Annual MBTU Savings</u>	<u>FY 84 TIC (\$000)</u>
<u>FY 82</u>		
JAAP Package Boiler Project	271,900	1,957
<u>FY 84</u>		
Selected ECAM Projects (Standby)	17,960	636
Selected ECAM Projects (Mobilization)	583,590	5,914
Viable Projects Not Selected (Standby)	1,000	72
Viable Projects Not Selected (Mobilization)	538,420	10,186
Increment G Projects (Standby)	6,400	184
Increment G Projects (Mobilization)	<u>12,450</u>	<u>182</u>
TOTAL	1,159,820	17,174
Increment E Projects (Central Boiler Plants)	<u>--</u>	<u>64,240</u>
	--	81,414

ENERGY CONSUMPTION
MBTU X 10⁶

LEGEND

EXISTING ENERGY CONSUMPTION

ANTICIPATED ENERGY CONSUMPTION

PROJECTED ENERGY CONSUMPTION

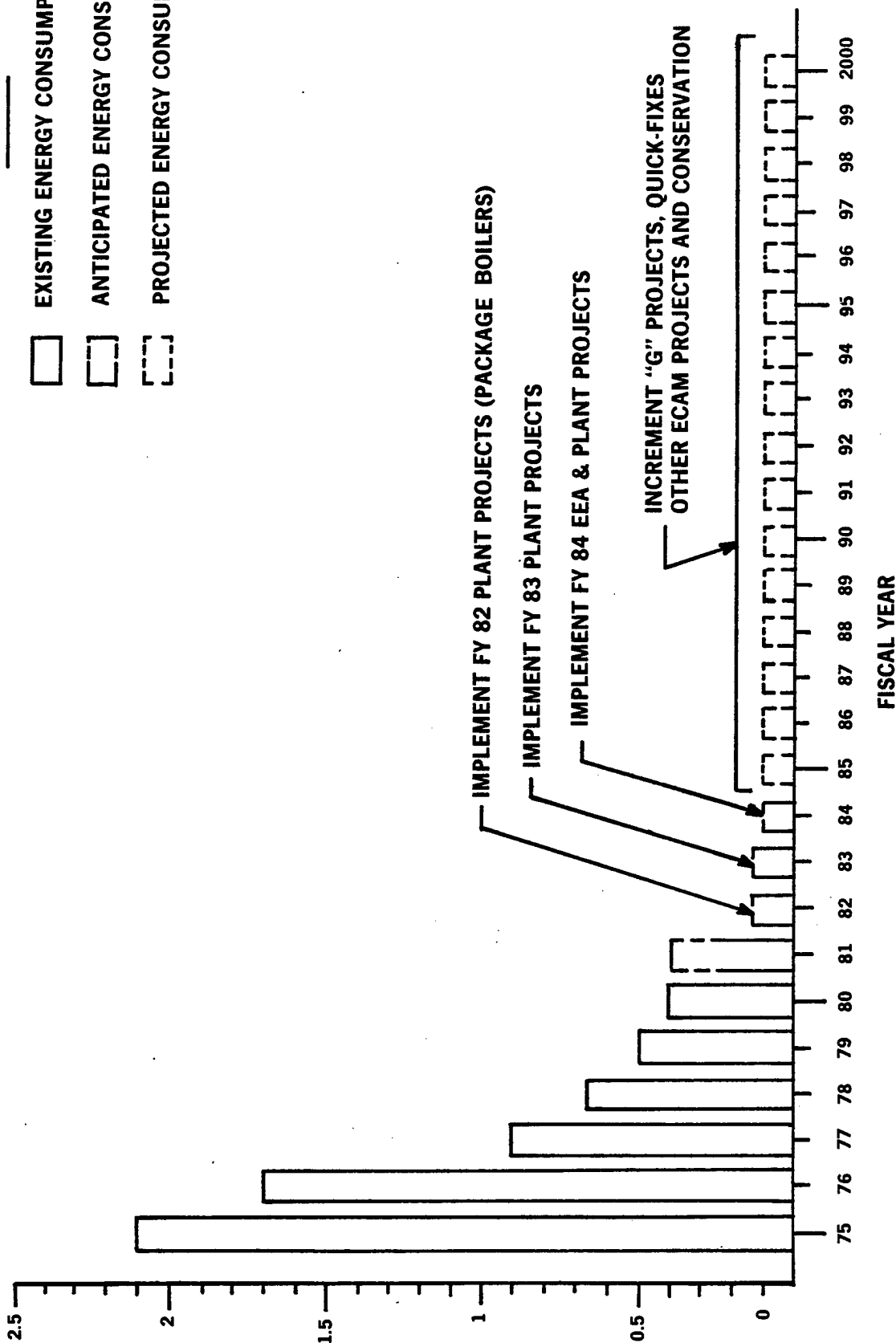
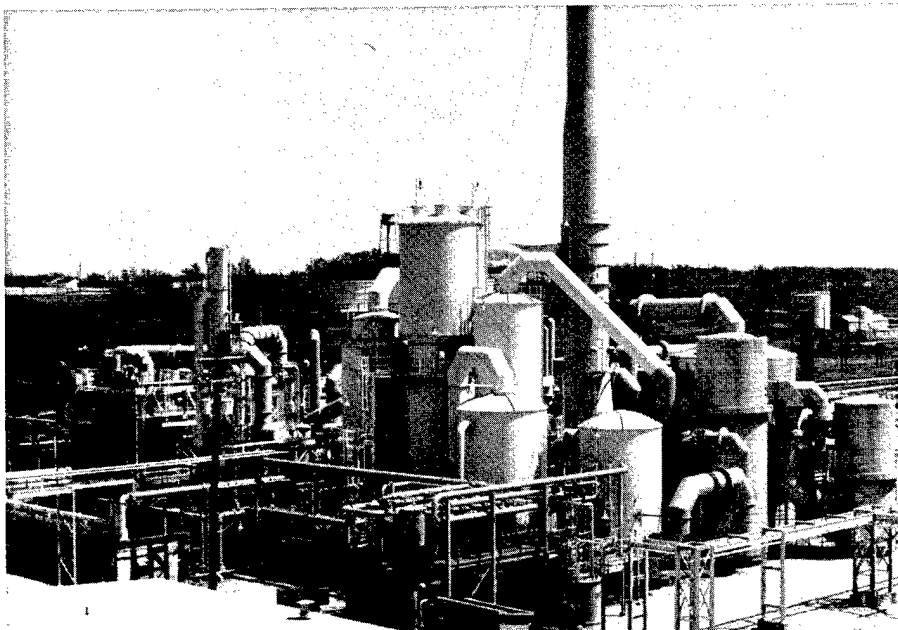
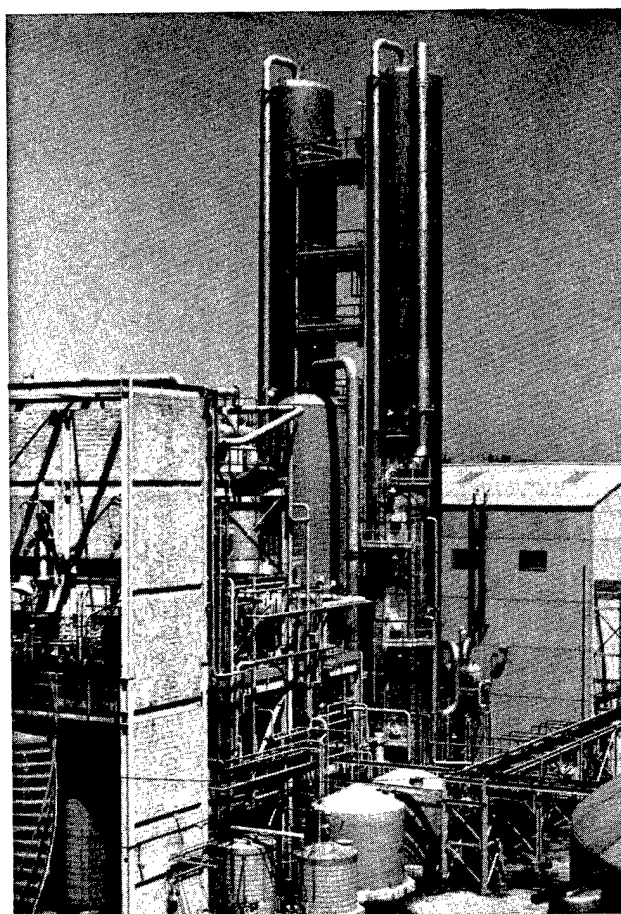


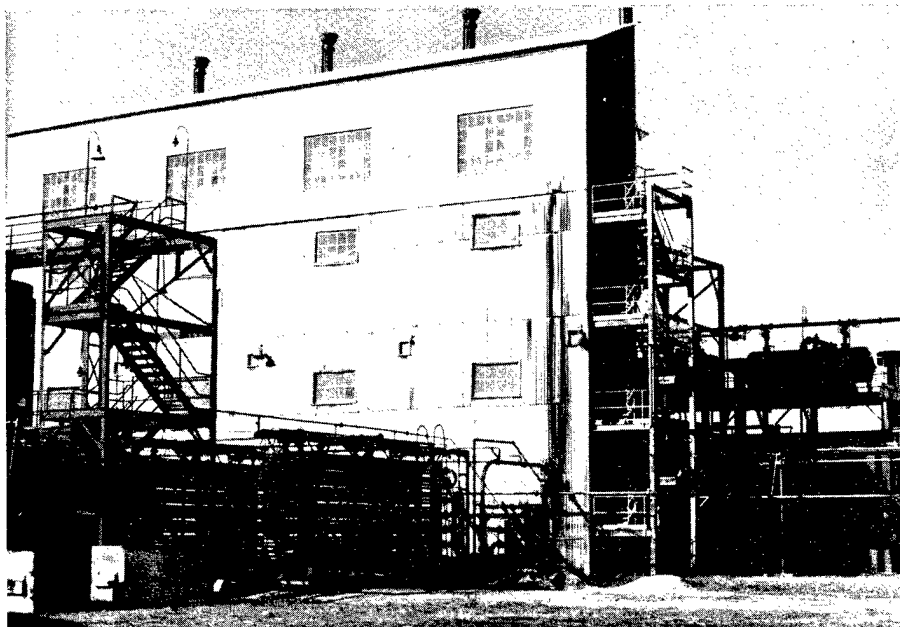
FIGURE 4
STANDBY STATUS-PROJECTED ENERGY CONSUMPTION



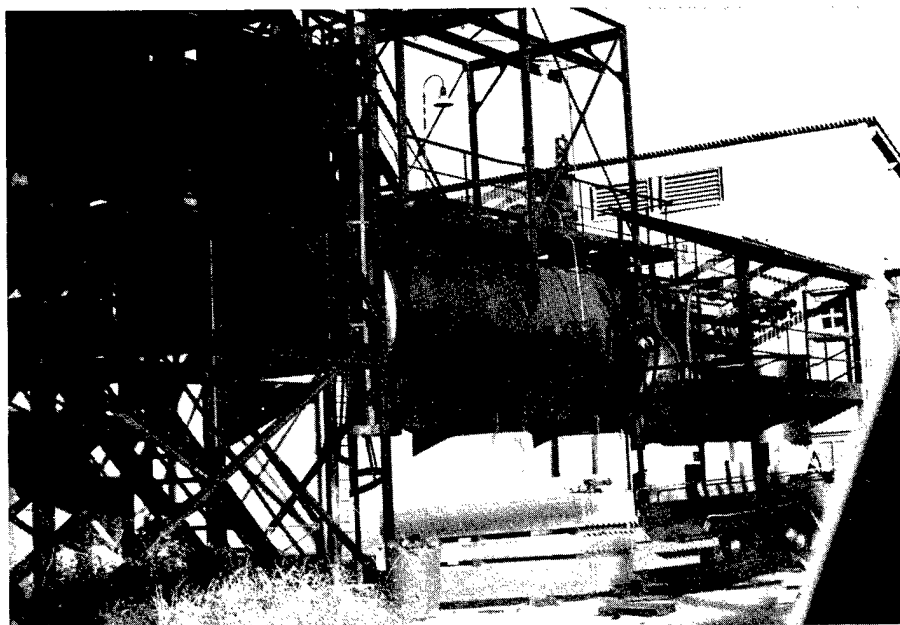
**ACID PLANT 4
SULFURIC ACID RECOVERY (SAR)**



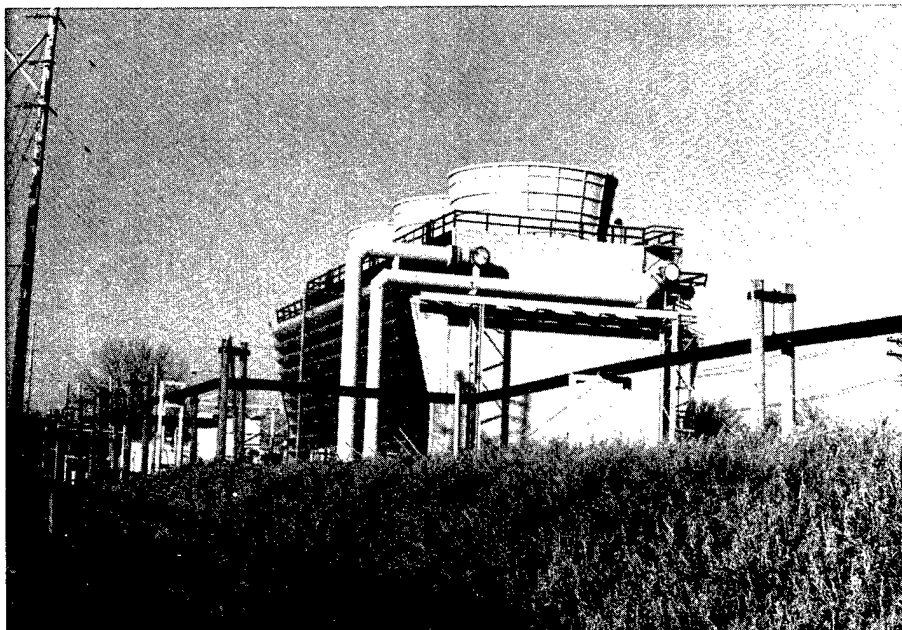
**ACID PLANT 4
DIRECT STRONG NITRIC (DSN)**



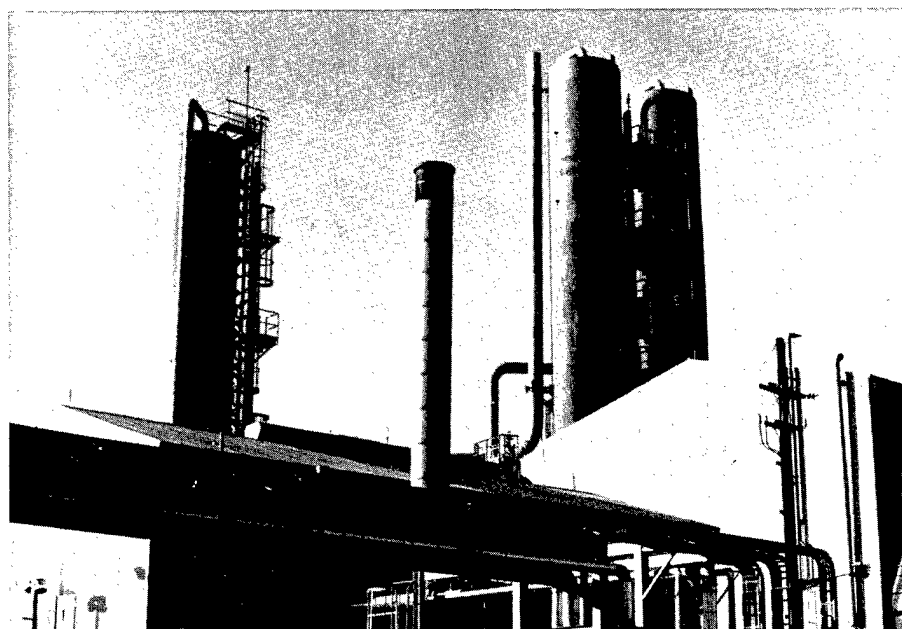
**ACID PLANT 1
AMMONIA OXIDATION PLANT (AOP)**



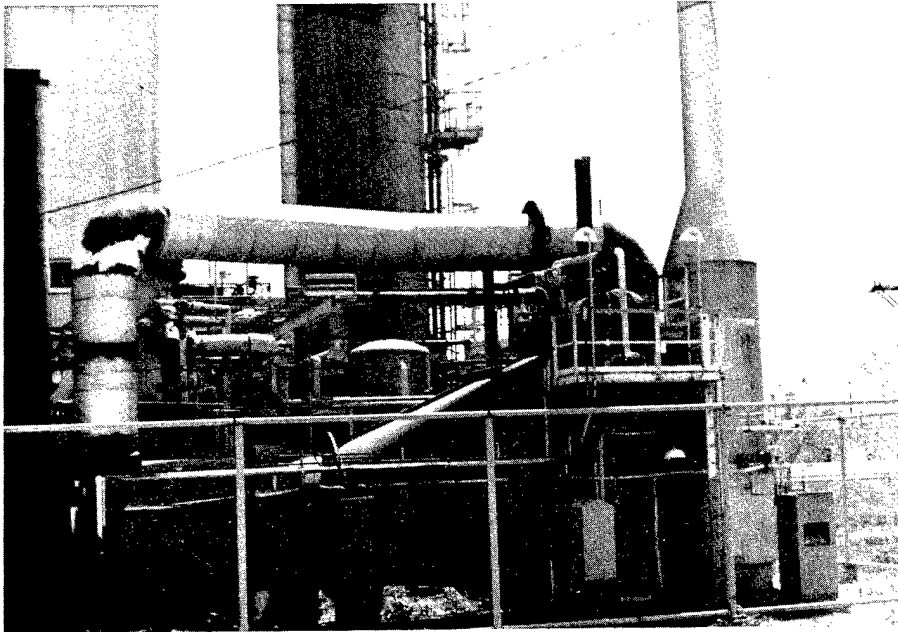
**ACID PLANT 3
SULFURIC ACID CONCENTRATOR (SAC)**



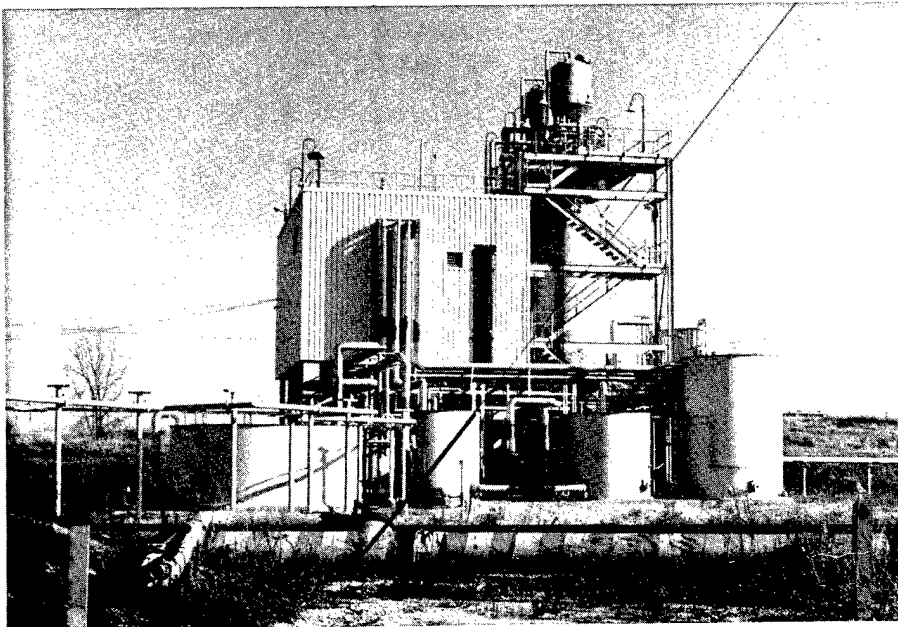
**ACID PLANT 4
COOLING TOWER**



**ACID PLANT 4
AMMONIA OXIDATION PLANT (AOP) LEFT
DIRECT STRONG NITRIC (DSN) RIGHT**



**NEW TNT LINE
ACID FUME RECOVERY PLANT (AFR)**



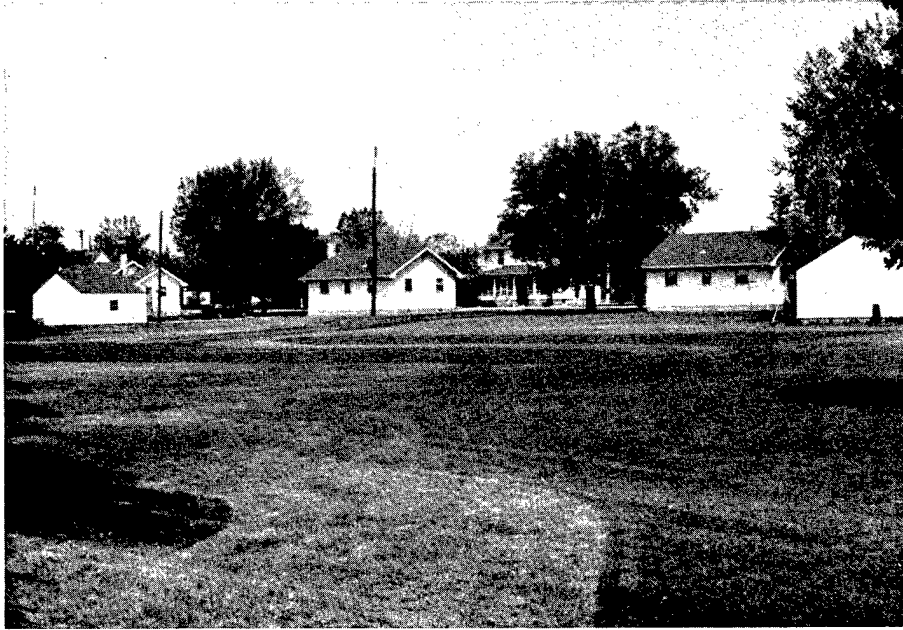
CARBON ABSORPTION UNIT



**FAMILY HOUSING
WHITE CIRCLE AREA**



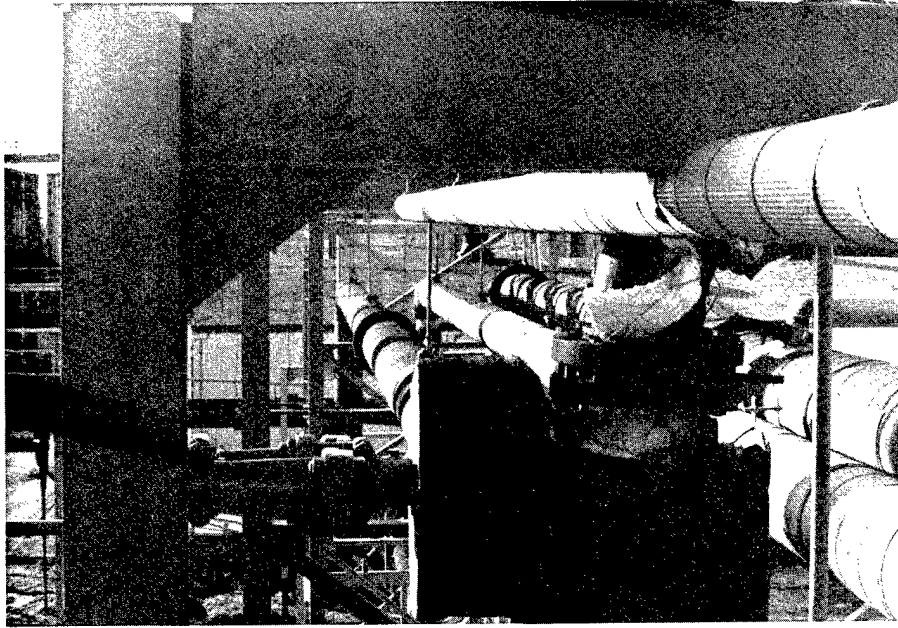
**FAMILY HOUSING
BROWN CIRCLE AREA**



**FAMILY HOUSING
WHITE CIRCLE AREA
PREFABRICATED HOUSING**



**FAMILY HOUSING
WHITE CIRCLE AREA
PREFABRICATED HOUSING**



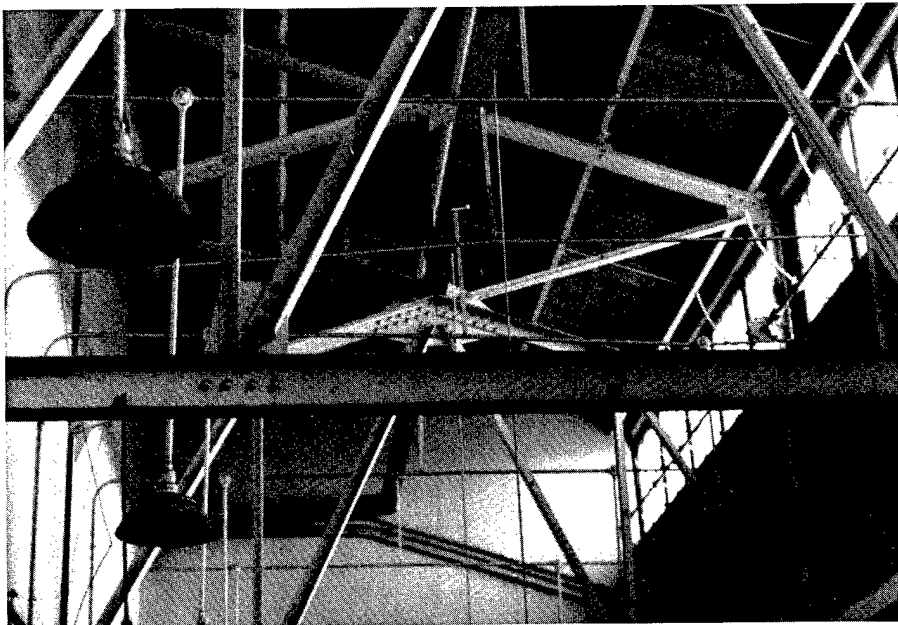
**STEAM DISTRIBUTION SYSTEM
DAMAGED INSULATION**



**STEAM DISTRIBUTION SYSTEM
SUBSTANDARD INSULATION**



**BUILDING 10-A GROUP 3
LOWER CEILING HEIGHT, INSULATE, AND ADD STRIP DOORS**



**GROUP 3
OPPORTUNITY FOR HIGH BAY DESTRATIFICATION
AND INSULATION**

DEFINITION OF TERMS

BENEFICIAL OCCUPANCY DATE (BOD)

The date a facility begins to operate.

BENEFIT-TO-COST RATIO (BCR)

The dollar savings realized over the life of the project divided by the non-recurring capital investment (including design). BCR is a measure of project payback. A BCR of 1.0, for example, means that the projects initial capital investment will be recovered over its lifetime.

COST INDEX

Comparison of Energy Cost Indices for various years giving a chosen base year a value of 100.

CURRENT WORKING ESTIMATE (CWE)

The project installation cost escalated to the year the project is programmed for implementation. Installation costs are non-recurring and include all labor and material, contractor costs, bond, contingency, SIOH, and escalation. Design costs are not included and must be added to the CWE to develop the total project cost.

ENERGY CONSERVATION AND MANAGEMENT (ECAM)

Military funded program for retrofitting existing DOD facilities to make them more energy efficient.

ENERGY CONSERVATION MEASURES (ECM)

Programs to conserve energy and/or costs through energy/manpower reductions.

ENERGY COST

Cost of Source Energy Consumed (obtained from utility bills).

ENERGY COST INDEX

Energy cost per square foot of building.

ENERGY MONITORING AND CONTROL SYSTEM (EMCS)

This is a computer-based control system used to achieve energy dollar savings through automatic control of building heating, ventilating and air conditioning (HVAC) systems.. This includes implementation of various energy conservation measures, such as programmed equipment shutoff, programmed outside air shutoff, and equipment optimization, to reduce the total energy consumption of individual buildings, reduce energy distribution system losses and improve HVAC system capability.

ENERGY-TO-COST RATIO (ECR)

The MBTU's per year saved divided by the non-recurring capital investment (excluding design). ECR is a measure of the amount of energy savings related to the required capital investment. Acceptable ECR's should be lower each year since energy costs escalate faster than capital investment costs.

ELECTRICAL ENERGY INDEX

Quantity of electricity per square foot of building area.

ELECTRICITY COST INDEX

Electricity cost comparison for various years using a base year with an assigned value of 100.

ELECTRICITY INDEX

Comparison of Electrical Energy Indices for various years to a chosen base year.

FUELS ENERGY INDEX

Ratio of BTU's of fuel consumed to the square footage of the base.

HEATING DEGREE DAYS

Total number of degree days based on 65°F.

HIGH TEMPERATURE HOT WATER (HTW)

A hot water heat transfer system generally using water above 350°F.

LAID-AWAY STATUS

Inactive buildings or equipment that are maintained in a state of readiness for mobilization.

MEDIUM TEMPERATURE HOT WATER (MTW)

A hot water heat transfer system generally using water between 230°F and 350°F.

MOBILIZATION STATUS

Period when the plant is operating at full production level.

SIMPLE AMORTIZATION PERIOD (SAP)

The project capital investment divided by the yearly savings. This yields the period of time required to recover the initial capital investment.

SOURCE ELECTRICITY ENERGY

Total amount of electricity purchased or total amount produced before line and efficiency losses.

SOURCE ENERGY CONSUMED

Sum of fuels consumed and electricity used (includes all fuels such as heating oil, diesel fuel, natural gas, propane, coal, etc.).

SOURCE ENERGY INDEX

Ratio of BTU's source energy consumed to square footage of the base.

SOURCE INDEX

Comparison of the Source Energy Indices for various years giving a chosen base year a value of 100.

STANDBY STATUS

Active or laid-away buildings or equipment used to maintain the plant at a reduced production level in readiness for mobilization.

TOTAL INSTALLED COST (TIC)

The sum of the CWE and the design costs.